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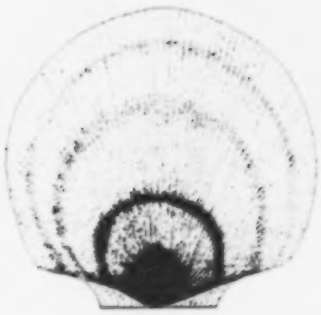
Science Advisory Report 2006/032

ASSESSMENT OF GEORGES BANK SCALLOPS (*PLACOPECTEN MAGELLANICUS*)



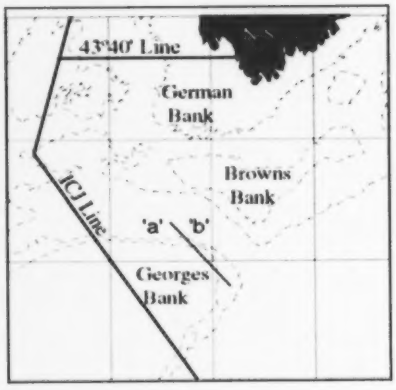


Figure 1: Location of Georges Bank.

Context

The sea scallop, Placopecten magellanicus, is found only in the Northwest Atlantic, from Cape Hatteras to Labrador. Scallops are aggregated in patches and harvestable concentrations are called beds. Major areas of offshore fishing activity are Georges Bank, the Eastern Scotian Shelf (Middle Grounds, Sable Island Bank, and Western Bank), Browns Bank, German Bank, and St. Pierre Bank (south of Newfoundland). Scallops prefer a sandy, gravel bottom and occur in depths of 35 to 120m on the offshore banks.

The offshore scallop fleet consists of wet fish vessels and freezer-trawlers. Generally, these vessels simultaneously fish two New Bedford offshore rakes or drags, 4 to 6.1 m width, one on each side of the vessel.

In support of management of the Georges Bank 2006 scallop fishery, a meeting of the Regional Advisory Process was held 20 April 2006 at the Bedford Institute of Oceanography, in Dartmouth N.S. to,

- *Assess the status of the resource*
- *Provide harvest advice for the 2006 fishery*
- *Provide methodology for annual advice until the next assessment*

Participants included DFO scientists and fishery managers, representatives of the industry and provincial government.

Annual assessments of the status of the offshore scallop resource take into account the annual survey findings, meat size distribution in the catch and fishery performance. The management of the main scallop fishery in Georges Bank refers to zone 'a' and is the focus of this document. Georges Bank zone 'b' is a marginal growth area for scallops and has a separate management plan.

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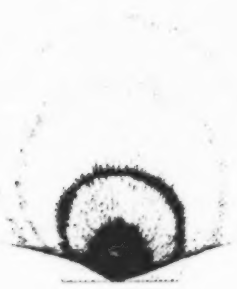

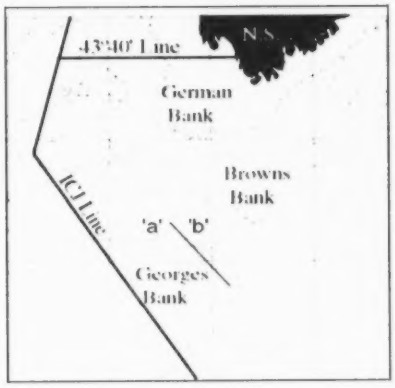

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Canada

SUMMARY

- Sea scallops on Georges Bank have been fished year round by the Canadian offshore scallop fleet under TAC since 1986. Prior to 1998, this area was managed as one unit but since 1998, it has been managed as two-zones, zone 'a' the traditional scallops grounds (a more productive area) and zone 'b' (a marginal production area).

- The 2005 TAC was 2500 t for zone 'a' and 200 t for zone 'b'. Total reported landings were 2484 t for zone 'a' and 201 t for zone 'b'. This year landings for zone 'a' are the lowest since 1998, landings for zone 'b' have remained at 200 t since 2002.

- The offshore scallop fleet fished primarily fresh scallop products until 2002. Since then, the offshore scallop fleet has incorporated the use of freezer trawlers. In the first year of fishing the freezer-trawlers landed nearly 10% of the TAC. In 2005, the freezer-trawlers have landed 57% of catches from zone 'a' and 58% of catches from zone 'b'.

- The 2005 fishing pattern shows a broad coverage of Georges Bank, albeit a higher concentration of effort on the northern edge of the Bank occurred consistently throughout the year.

- Commercial catch rates reached historical high levels during 2000 - 2002 and have since declined to average levels.

- Survey catch rates for scallops in zone 'a' for both recruits (age 4+) and pre-recruits (age 3) peaked in 2000. The age 4+ number per tow declined since 2000, with a slight recovery in 2005 to above the long-term average. The age 3 number per tow declined from 2000 to 2003 and has increased during the last two years to above the long-term average.

- The fishery targeted biomass (ages 4 to 7) for zone 'a' from a population model has been declining since a peak in 1999. In 2005, it is estimated at 15,000 t, which corresponds to the long-term average. In 2005, age 5 scallops contributed 28% of the targeted biomass and new recruits at age 4 contributed only 16%.

- A range of 2006 TAC scenarios for zone 'a' from 2,500 t to 8,000 t are expected to produce exploitation rates of 8 to 32% on the targeted biomass (Age 4-7), and declines in targeted biomass of 2 to 32%.

BACKGROUND

Species Biology

Scallops may reach sexual maturity as early as age 2 and have separate sexes. The female gonad is red in colour and the male gonad is creamy white. The major spawning period is from August to October, eggs and sperm are released into the sea and fertilization is external. Fertilized eggs develop into a ciliated larval stage (veliger) in a few days, and will continue to develop while swimming in the water column for 30 to 60 days before settlement to the bottom. Newly settled larvae undergo a series of morphological changes before becoming a juvenile scallop.

Scallop growth is estimated from the position of annual rings on the shell. The growth rates vary from one fishing area to another and are influenced by season, depth and temperature.

Fishery

Table 1. Georges Bank (zone a and b) landings ('000s t of meat).

Year	1980-1989 Avg	1990 – 1999 Avg	2000	2001	2002	2003	2004	2005
TAC	-	4.5	6.8	6.9	6.7	6.2	3.7	2.7
Landings	5.1	4.5	6.8	6.9	6.7	6.2	3.7	2.7

Sea scallops on Georges Bank have been fished year round by the Canadian offshore scallop fleet under TAC since 1986. Prior to 1998, this area was managed as one unit but since 1998, it has been managed as two-zones, zone 'a' the traditional scallops grounds (a more productive area) and zone 'b' (a marginal production area). In 2005, TAC and landings for zones 'a' and 'b' were 2,700 t (Table 1), the lowest recorded landings in the last decade (Fig. 2).

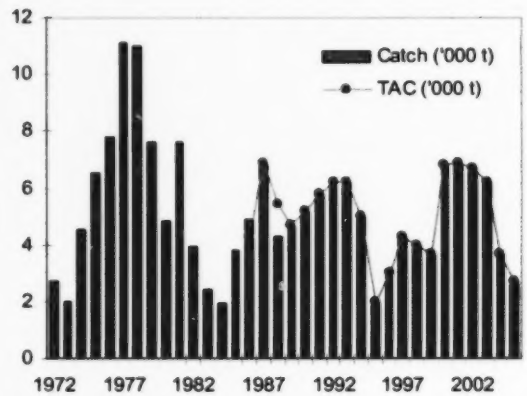

Figure 2. Georges Bank scallop landings and TAC for zone 'a' and 'b'.

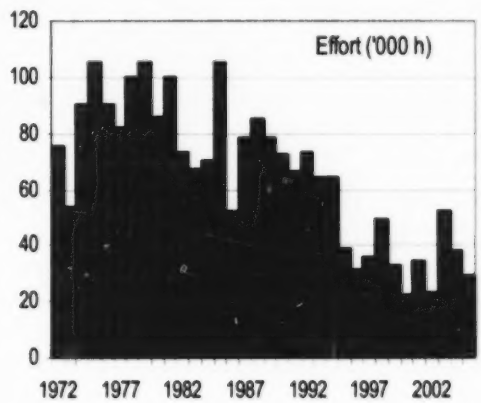

Figure 3. Georges Bank scallop fishing effort for zone 'a' and zone 'b'.

The 2005 management plan for zone 'a' included a TAC of 2500 t and a meat count of 33 meats per 500 grams. The 2005 management plan for zone 'b' included a 200 t rolling TAC and a meat count of 50 meats per 500 grams. A rolling TAC quota for zone 'b' is evaluated at the end of the first fishing period; if commercial catch rates (CPUE) and meat counts are maintained, a further 200 t rolling TAC may be considered for the rest of the fishing period. Even when these conditions are met, industry may decide not to implement the second roll. The 200 t TAC has not been rolled over since 2002, although extensions to the fishing period have occurred.

The offshore scallop fleet fished for primarily fresh scallop products until 2002. Since then, the offshore scallop fleet has incorporated the use of freezer-trawlers, while continuing with the use of wet fish vessels. In the first year of fishing (2002), the freezer-trawlers landed nearly 10% of the TAC. In 2005, the freezer-trawlers landed 1410 t (57% of TAC) of frozen scallop meats, and the wet fish vessels landed 1072 t fresh scallop meats from zone 'a'. From zone 'b' the freezer trawlers landed 118 t (58% TAC) of frozen scallop meats and the wet fish vessels landed 84 t of fresh scallop meats.

The 2005 fishing pattern shows a broad coverage of Georges Bank, albeit a higher concentration of effort on the northern edge of the Bank occurred consistently throughout the year. The overall effort in both zones 'a' and 'b' declined from 1972 to 2005 (Fig. 3). Satellite based monitoring of offshore scallop fishing activities is accumulated on an hourly basis (Fig. 4).

Most of the fishing activity was concentrated in the third (Q3) and fourth quarter (Q4). To avoid fishing in an area of juvenile scallops a voluntary 'no fishing zone' was established by the offshore scallop industry in November 2004 as the mid-northern area shows no effort (Fig. 4).

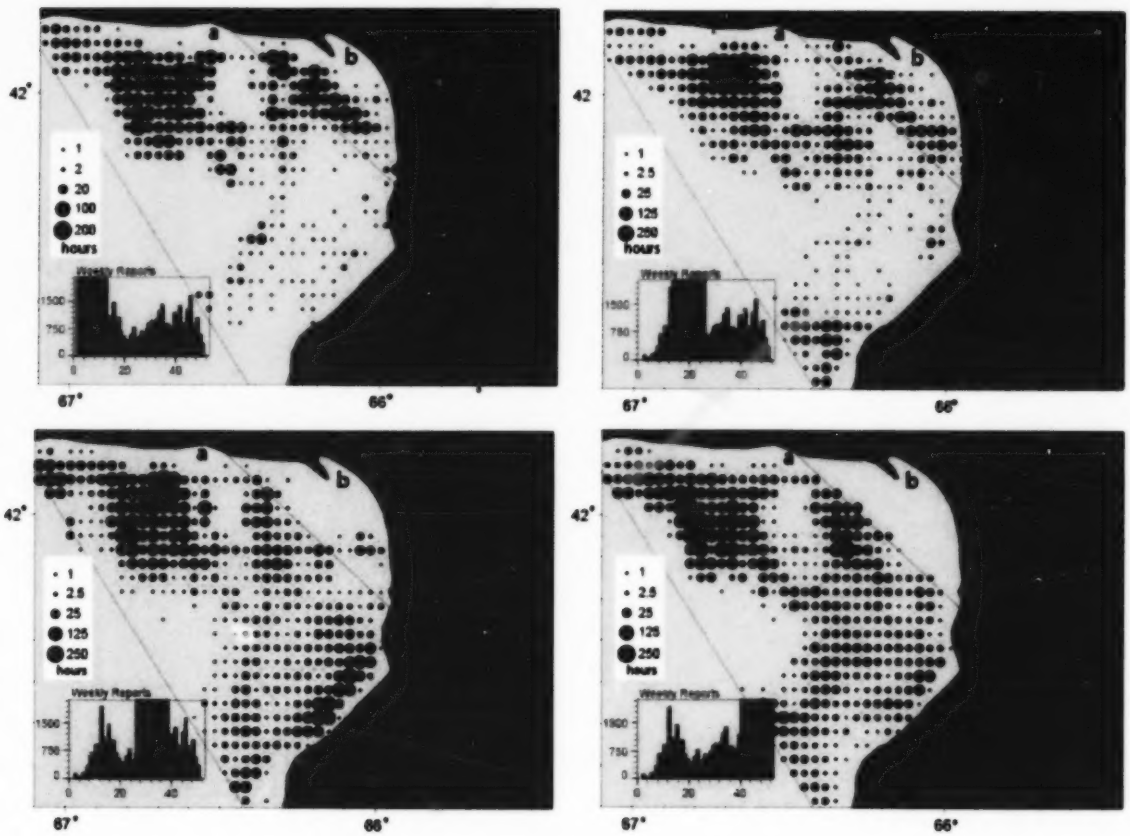

Figure 4. Spatial distribution of quarterly effort (hours polled) on Georges Bank zone 'a' and zone 'b' from satellite tracking data during 2005. Data has been aggregated by 2-minute cells.

Meat weight data are collected from 100% of the landings through a port sampling program that is fully funded by the offshore scallop industry. The 2005 meat distribution tends toward smaller meats, and is now similar to the long-term average distribution (Fig.5).

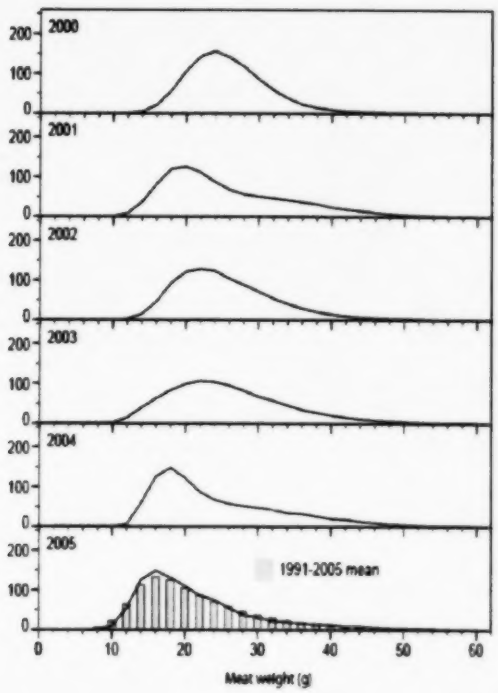

Figure 5. Meat weight distribution from Georges Bank zone 'a' scallop landings.

ASSESSMENT

Stock Trends and Current Status

Logbooks from the offshore scallop fleet provide catch and effort data from which catch rates (CPUE) are estimated. Landings are monitored at dockside. Catch in numbers at age are determined from port samples. Relative biomass indices were derived from research surveys. A Sequential Population Analysis model estimated population abundance based on research survey biomass indices, commercial catch rates, and age composition of the stock.

Commercial catch rates reached historical high levels during 2000 - 2002 and have since declined to average levels (Fig. 6). High catch rates were observed in the northern edge of zone 'a' (Fig. 7), an area that also had greater effort by the fleet.

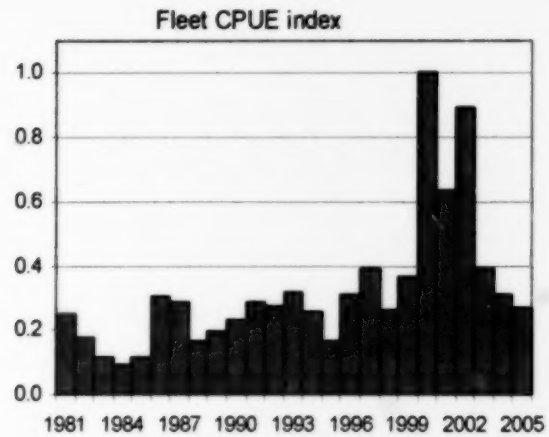

Figure 6. Georges Bank zone 'a' commercial catch rates.

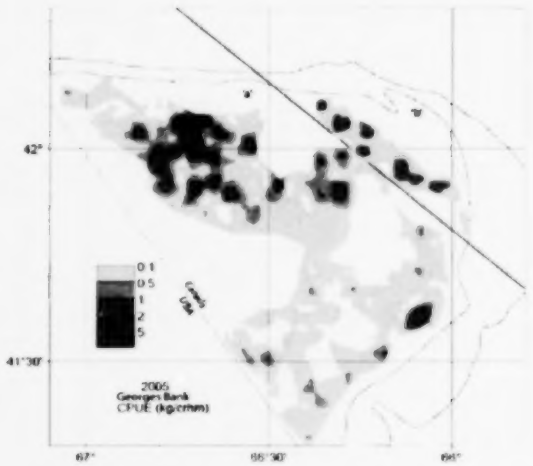

Figure 7. Spatial distribution of Georges Bank zone 'a' and zone 'b' 2005 catch rates

Survey catch rates for scallops (Fig. 8) in zone 'a' for both recruits (age 4+) and pre-recruits (age 3), peaked in 2000. The age 4+ number per tow declined since 2000, with a slight recovery to above the long term average of 95 scallops per tow. The age 3 number per tow declined from 2000 to 2003, and has increased during the last two years to above the long-term average of 101 scallops per tow.

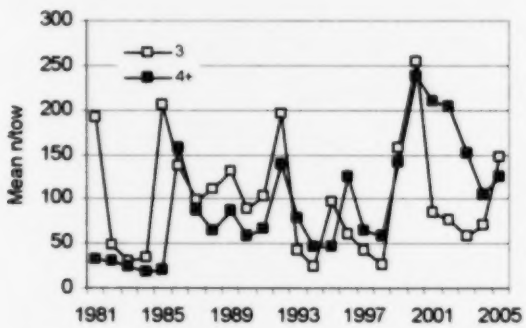

Figure 8. Mean number per tow for age 3 (pre-recruits) and age 4+ (recruits) from Georges Bank annual surveys.

The spatial distribution of scallop abundance for ages 4 to 7 from the research survey (Fig. 9) shows that the aggregations of recruits at age 4 are restricted to the northern portion of the Bank. The age 5 occur in lower densities in the mid-northern portion of the bank and toward the southern edge. Ages 6 and 7 are concentrated in the southeast part of the Bank.

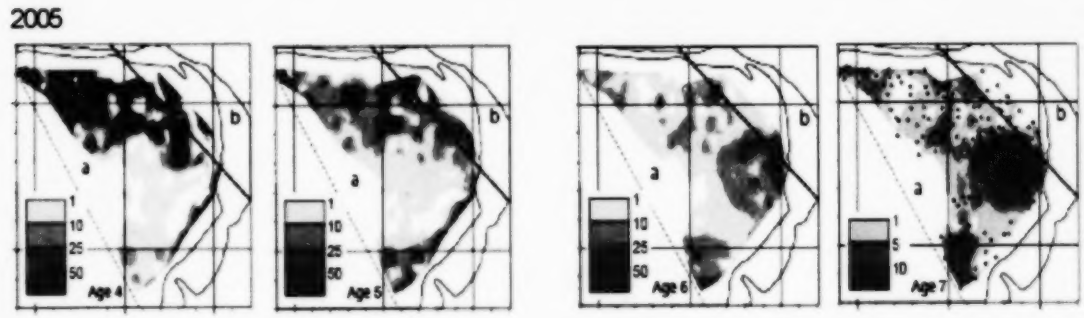

Figure 9. Spatial distribution of scallops ages 4 to 7, as mean number per tow from the 2005 annual survey on Georges Bank. The positions of the survey tows are shown on the map for age 7.

The 2005 biomass index for fully recruited scallops (>100 mm shell height) is currently similar to the 2004 level and although it has decreased from the 2000 – 2003 period, it is above average. The pre-recruits biomass index (90-100 mm shell height) has shown a slight increase since 2004 (Fig. 10).

The condition of the scallop stock is monitored using a meat weight index for a standard 100 mm shell height scallop (Fig. 11). From 1985 to 1998, the mean meat weight of a scallop of 100 mm was about 15 g. During 1999-2003, the meat weight of 100 mm scallop increased to almost 17 g. In the last two years, the meat weight index has decreased to pre-1999 values and is now below the long-term average.

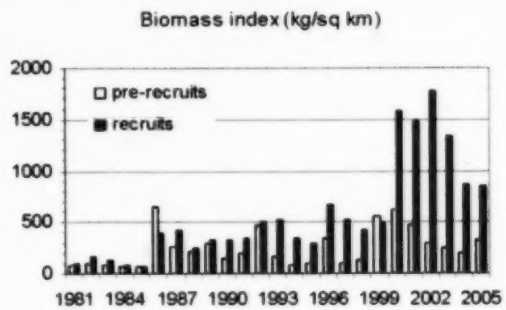

Figure 10. Biomass index (kg/km^2) for pre-recruits (90-100 mm) and recruits (>100 mm).

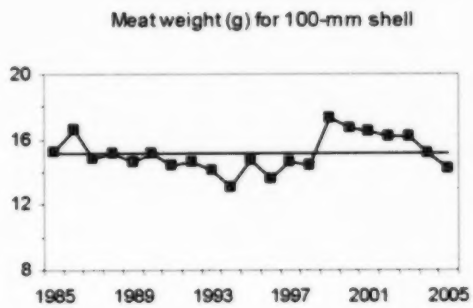

Figure 11. Predicted meat weight (g) for a 100 mm shell height for Georges Bank zone 'a'. Line is long term average.

The fishery-targeted biomass from a population model (ages 4 to 7), has been declining since reaching a peak in 1999. In 2005, it is estimated at 15,000 t (Fig. 12), which corresponds to the long-term average. In 2005, age 5 scallops contributed 28% of the targeted biomass and new recruits at age 4 contributed only 16%.

Age 3 scallops considered pre-recruits increased in abundance from 2004 (Fig. 13) and are now about average for zone 'a'.

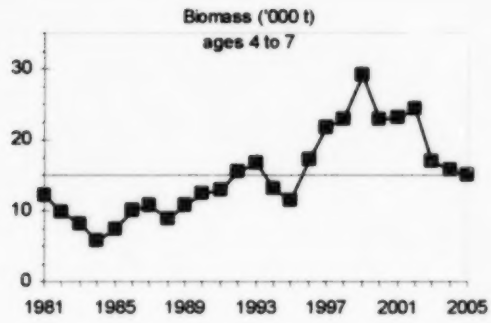

Figure 12. Population biomass for age 4-7 ('000 t, meat weight). Line is long-term average.

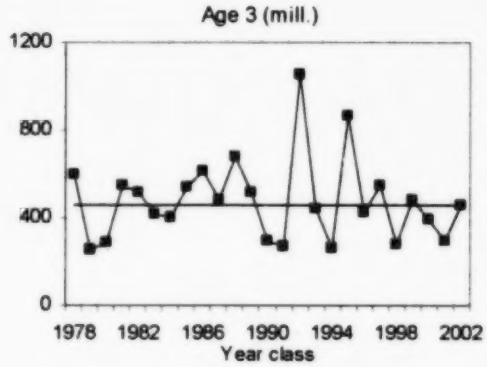

Figure 13. Time series of estimated population numbers at age 3 (in millions). Line is the average for 1978-2002 year classes.

The introduction of restrictions of small meats in the catch starting in 1995 has reduced the exploitation rate of age 3 scallops to near zero (Fig. 14). In 2005 the exploitation rate on age 4+ was 12%, which is a quarter of the original exploitation rate in 1981 (48%).

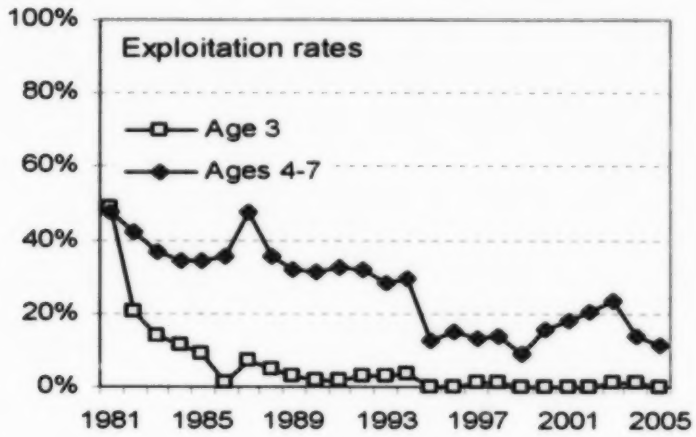

Figure 14. Exploitation rates expressed as percentages for Age 3 (pre-recruits) and Age 4+ (recruits).

High exploitation rates observed in the 80's and 90's have decreased and biomass for age 4–7 has been higher than 15,000 t since 1992, with the exception of 1994-1995 (Fig.15).

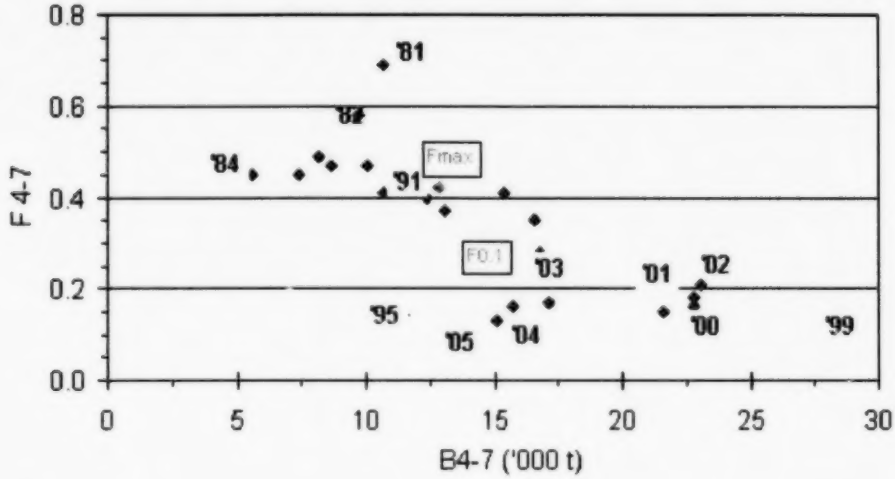

Figure 15. Historical relationship (1981-2005) between biomass of age 4-7 scallops and fishing mortality rates for age 4-7.

A summary of trends and current status of resource indices are presented in the following table.

Table 2: Recent trends and current status of various indices of the Georges Bank offshore scallop fishery.

Index	Recent trend	Current status
Pre-recruitment RV age 3 1981 – 2005	Increase over last two years	Above average
Biomass estimate Age 4 - 7 1981- 2005	Decreasing From record high	Average
RV biomass Ages 4 – 7 1981 – 2005	Decreasing over last 3 years	Above average
Meat weight Index 1985 – 2005	Decreasing from record high	Below Average
CPUE 1981 – 2005	Decreasing From record high	Average
Exploitation estimate Ages 4 to 7 1981 – 2005	Decreasing since 2003	Below average

Sources of Uncertainty

The projection results carry certain degree of uncertainty that is a function of how well year-class strengths are estimated. Juvenile scallops (Age 2) are difficult to estimate. Pre-recruits tend to be highly aggregated which can cause high sampling variance in the estimates.

There is spatial heterogeneity in the distribution of age groups. The offshore scallop fleet targets scallop beds where larger scallop resides. This targeting could bias the catch-rates used in annual assessments.

The strength of the assessment model is the wealth of long-term survey data on which it is based, although the lack of recent aging data for the area is a concern, and could weaken the projections.

CONCLUSIONS AND ADVICE

Given the distribution and abundance of the target age group (ages 4 – 7) in zone 'a' at the beginning of 2006, evaluation of catch scenarios based upon the population model (Table 3) indicate that any catch scenario above the interim 2006 TAC of 2,500 t implies exploitation rates for ages 4 – 7 higher than 8%, and a decrease in stock biomass greater than 2% for the same age group.

Table 3: Proposed scenarios of 2006 TAC levels and corresponding impact on population biomass as estimated from the Sequential Population Analysis model.

TAC (t)	Exploitation rate During 2006		Biomass (t) end of 2006		Change in B3+ during 2006	Change in B4-7 during 2006
	Age 3+	Ages 4-7	Age 3+	Ages 4-7		
2,500	6%	8%	26,074	18,000	+15%	-2%
3,000	7%	9%	25,663	17,700	+13%	-4%
3,500	9%	12%	25,163	17,360	+12%	-6%
4,000	10%	13%	24,774	16,850	+10%	-9%
5,000	14%	18%	23,841	16,450	+5%	-12%
8,000	25%	32%	20,867	14,000	-7%	-32%

Regional Advisory process (RAP) meetings will occur when a major change in the fishery takes place and/or the methods of evaluating the stock status need to be reviewed, assessed or modified. For the years with no scheduled RAP, scientific advice for the Georges Bank offshore scallop fishery will be provided directly to fisheries managers.

SOURCES OF INFORMATION

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ISSN 1480-4913 (Printed)
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CORRECT CITATION FOR THIS PUBLICATION

DFO, 2006. Assessment of Georges Bank Scallops (*Placopecten magellanicus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/032.